

# **Development of Nutrient Criteria in New Mexico, 2008**

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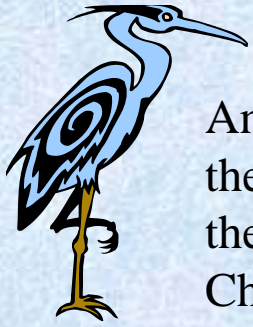


In New Mexico stream nutrient threshold values are being developed and tested in the Assessment Protocol which ... has 2 levels:

1) **Screening level** with some water quality data and *qualitative* algal biomass evaluation

2) **Assessment level** with more water quality data and *quantitative* algal biomass evaluation

The assessment level uses a weight of evidence approach with a number of indicators and looks like ...



## Level II Nutrient Assessment Form using Threshold Values

An Assessment Unit will be determined to be not supporting if **three or more** of the following indicators are present (if not all of the indicators have been measured, the presence of two of the following indicators will be assessed as not supporting). Check all indicators that exceed the threshold values below.

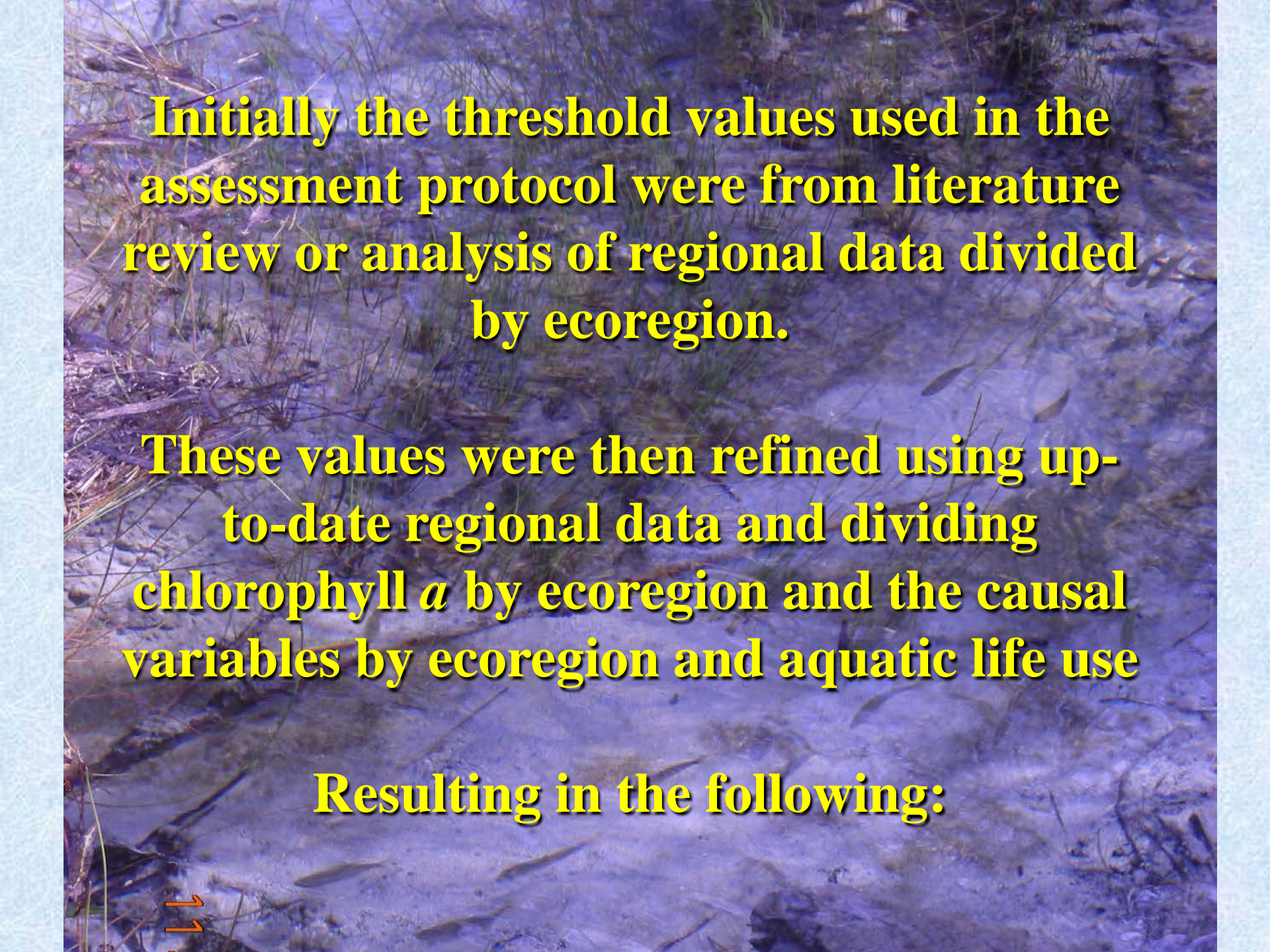
- ☐ **Total nitrogen** is above the ecoregion criterion in >15% of samples
- ☐ **Total phosphorus** is above the ecoregion criterion in >15% of samples
- ☐ **Dissolved Oxygen** threshold is exceeded
  - ( ☐ ) determined to be **not supporting** using the assessment protocol for Data Collected with Continuous Recording Devices
  - ( ☐ ) >15% of grab samples exceeded 120%
  - ( ☐ ) >15% of grab samples are below the applicable standard
- ☐ **pH** threshold is exceeded
  - ( ☐ ) determined to be **not supporting** using the assessment protocol for large pH data sets
  - ( ☐ ) >15% of grab samples exceeds appropriate criterion
- ☐ The **Algal Bioassay** indicates moderately high or high algal production
- ☐ **Algal biomass** threshold is exceeded
  - ( ☐ ) AFDM is greater than 5000  $\mu\text{g}/\text{cm}^2$
  - ( ☐ ) Chlorophyll *a* concentration is greater than 10  $\mu\text{g}/\text{cm}^2$

**In addition to the ecoregions and designated use based nutrient criteria for TN and TP the following response variables are or will be used in assessing nutrient impairment of the State's streams and rivers:**

- **Dissolved Oxygen**
  - **Concentration** (assessed with large data set protocol) or
  - **Dissolved Oxygen Saturation**
- **pH** (assessed with large data set protocol)
- **Chlorophyll *a* Concentration**
- **Benthic Macroinvertebrates Stream Community Index and/or Hilsenhoff Biotic Index**  
*(still under development)*
- **Nutrient Diatom Index** *(still under development)*

**SWQB has provided PANS with 330 stream and river periphyton samples. These data are currently being analyzed.)**



The background of the slide is a photograph of a pond. In the foreground, there are several water lilies with dark green, pointed leaves floating on the water. Some lily pads are partially submerged. In the background, there are tall, thin reeds or grasses growing out of the water. The water is a light blue-grey color. The overall scene is a natural, aquatic environment.

**Initially the threshold values used in the assessment protocol were from literature review or analysis of regional data divided by ecoregion.**

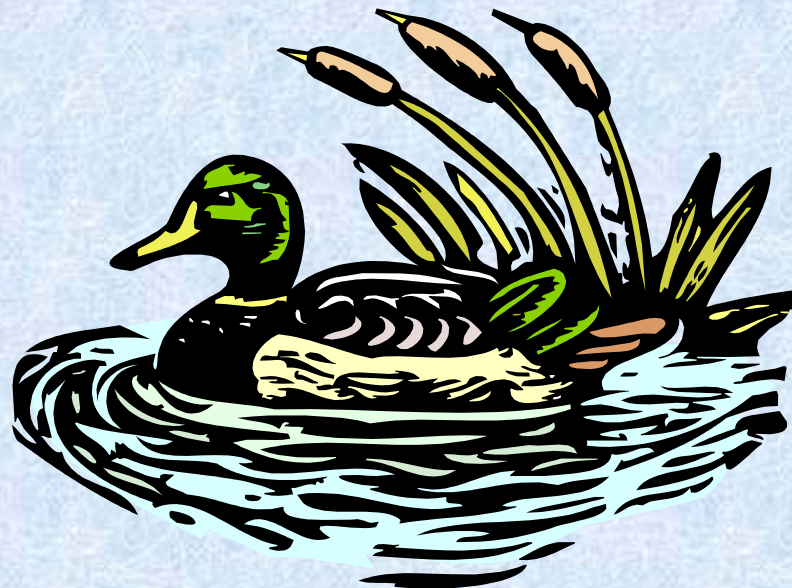
**These values were then refined using up-to-date regional data and dividing chlorophyll *a* by ecoregion and the causal variables by ecoregion and aquatic life use**

**Resulting in the following:**



# Ecoregional Chlorophyll *a* threshold values (95th percentile) in $\mu\text{g}/\text{cm}^2$

21- Southern Rockies	22/20- AZ/NM Plateau	23- AZ/NM Mountains	24/79- Chihuahuan Desert	26/25- Southwest Tablelands
5	8	7	17	11



## **The new TN & TP values were developed in the following manner:**

- Data were compiled from the national nutrient dataset (1990-1997), STORET (1998), and NMED SQWB In-House Database (1999-2005). Parameters included TP, Total Kjeldahl Nitrogen (TKN), and Nitrate Plus Nitrite (N+N)
- GIS coverages were used to assign ecoregions and aquatic life uses (ALU)
- The data were divided first by ecoregion then by ALU and the 50<sup>th</sup> percentile was calculated for each parameter: TP, Total Kjeldahl Nitrogen (TKN), and Nitrate Plus Nitrite (N+N)
- The TKN and N+N percentiles were then added

# Ecoregion and Aquatic Life Use

## Nutrient Thresholds for Streams (mg/L), using regional data and the 50<sup>th</sup> percentile

	<b>21 – Southern Rockies</b>		<b>22 – AZ/NM Plateau</b>		<b>23 – AZ/NM Mountains</b>		<b>24 – Chihuahuan Desert</b>	<b>26 – Southwest Tablelands</b>		
TN	0.25		0.35		0.25		0.53	0.38		
TP	0.02		0.05		0.02		0.04	0.03		
<b>A L U</b>	CW	T – WW (volcanic)	CW	T – WW	CW	T – WW	T – WW	CW	T	WW
TN	0.25	0.25	0.28	0.48	0.25	0.29	0.53	0.25	0.38	0.45
TP	0.02	0.02 (0.05)	0.04	0.09	0.02	0.05	0.04	0.02	0.03	0.03

CW = Coldwater Aquatic Life Use  
T = Transitional Aquatic Life Use  
WW = Warmwater Aquatic Life Use





## Censored Data



- 20 - 40% of the data is below detection limit
- Use of the substitution method, i.e. filling in  $\frac{1}{2}$  the detection limit for the less than values may be skewing the percentiles?
- Used recommended nonparametric methods for calculating descriptive stats and... **it did not make much difference!**

**Comparison of percentiles (mg/L) calculated using the substitution and Kaplan-Meier methods. The proportion of the data that was below the detection limit is show in the % < DL columns.**

**Total Phosphorus**

Phos_Group	n	25th	50th	%<DL
21-substitut.	2160	0.015	0.020	41
21-Kap-Meier		*	0.020	
22-substitut.	320	0.020	0.040	19
22-Kap-Meier		0.020	0.040	
23- substitut.	855	0.020	0.020	49
23-Kap-Meier		0.003	0.020	
24- substitut.	149	0.040	0.070	7
24-Kap-Meier		0.040	0.070	
26- substitut.	502	0.010	0.020	42
26-Kap-Meier	428	*	0.020	45

**Total Kjeldahl Nitrogen**

TKN group	n	25th	50th	%<DL
21- substitut.	2167	0.100	0.200	24
21-Kap-Meier		0.100	0.200	
22- substitut.	399	0.115	0.330	22
22-Kap-Meier		0.130	0.330	
23- substitut.	864	0.110	0.200	19
23-Kap-Meier		0.120	0.200	
24- substitut.	140	0.100	0.250	34
24-Kap-Meier		*	0.270	
26- substitut.	494	0.158	0.325	18
26-Kap-Meier		0.160	0.316	

# Implementation Concerns

- Percentile-derived threshold values are fair indicators of nutrient enrichment when used with other parameters in a weight of evidence approach. The addition of a nutrient diatom index will help strengthen this assessment.
- However, these values are also used as numeric translators for TMDLs and NPDES permits, but they are:
  - Currently not tied to impairment
  - Considerably lower than what is technologically achievable for WWTPs

**Are they suitable for these applications ???**



# Lakes and Reservoirs





# Lakes Dataset



- In 2006 and 2007, SWQB sampled 25 lakes and reservoirs, including cirque lakes, sink holes, and warm and coldwater reservoirs
  - Total Phosphorus
  - Total Kjeldahl Nitrogen
  - Nitrate Plus Nitrite
  - Secchi depth
  - Chlorophyll *a* concentration
  - Phytoplankton Community Comp.
  - Diatom Community Comp.
  - Dissolved Oxygen
- Water quality data from 2000-2007 is in the SWQB Database
- Water quality data from 1980-1999 is uploaded to STORET
- All diatom and phytoplankton data is in word documents. Apparently none of the BIOS data was transferred to archival STORET !!!

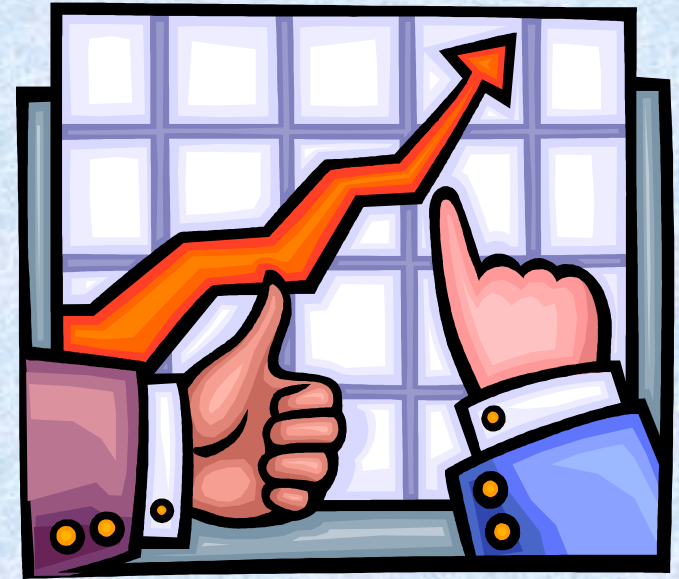


# Use Support Rating

SWQB will attempt to develop a use support rating for reservoirs based on a number of parameters such as:

- Fishing success
- Frequency of fish kills
- Extent of anoxic conditions
- Diatom index

**The nutrient variables will then be compared to the use support rating to identify the thresholds at which the use is impaired.**





# Rivers ???





# Preliminary River Definition

- SWQB is distinguishing rivers from streams by defining systems that cannot be monitored effectively with the biological and habitat methods developed for wadeable streams. These rivers also generally meet the Simon and Lyons (1995) definition of great rivers as those having drainage areas greater than 2,300 square miles. There are many systems in New Mexico that meet the great river definition but are suitable to wadeable streams monitoring methods due to the arid nature of the region.
- The systems currently included in the "rivers" waterbody type are:
  - The San Juan River from below Navajo Reservoir to the Colorado border
  - The Rio Grande in New Mexico,
  - The Pecos River from below Sumner Reservoir to the Texas border,
  - The Rio Chama from below El Vado Reservoir to the Rio Grande,
  - The Canadian River below the confluence with the Cimarron River,
  - The Rio Puerco below the confluence with the Rio San Jose, and
  - The Gila River below Mogollon Creek.

**SWQB is currently compiling a dataset for this waterbody type**

**SWQB will use multivariate analysis to determine how these systems group with respect to diatom community composition**

# Questions???

- Use of annual average threshold rather than percent of grab samples
- How to deal with DO profiles in lakes (average top 3 meters, proportion below the applicable standard, ...)?
- How to tie this to use support?
  - SWQB considering a “use support” rating system, which would include biotic community composition and other variables.
- Are other states using threshold values for TMDLs and permits?



# Future Work

- ❑ Collect more regional data on algal biomass, diurnal DO patterns, and associated nutrient levels from rivers and lakes.
- ❑ Incorporate biotic indices (benthic macroinvertebrates and diatoms) into our assessment protocol.
- ❑ Examine other classification schemes (besides ecoregion).
- ❑ Test monitoring methods for non-wadeable systems.
- ❑ Develop a use support rating for rivers, lakes, and reservoirs.
- ❑ Analyze lake and reservoir data with use support rating to define threshold values for TP, TN, chlorophyll *a*, and secchi depth.
- ❑ Research the use of DO fluctuations and saturation.



**THE END**

**<http://www.nmenv.state.nm.us/swqb/Nutrients/index.html>**

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